



# IHSS-N1

## WELDED HONEYCOMB CORE SPECIFICATION

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**REVISIONS**

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<b>A</b>	<b>8/25/2009</b>	<b>Added data</b>	<b>2, 5, 6, 7</b>	
<b>B</b>	<b>03/13/2010</b>	<b>Added perforation definition; diagrams.</b>	<b>6</b>	
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## 1. SCOPE

The purpose of this specification is to establish configuration and acceptability limits for welded metallic structural honeycomb.

## 2. APPLICABLE DOCUMENTS

Honeycomb manufactured to this specification shall meet requirements of Purchase Agreement or Contract, Engineering Drawing, Material Specification or other applicable documents.

In the event of conflict of documents following precedence shall take place:

1. Purchase Agreement or Contract
2. Engineering drawing
3. Honeycomb Specification as identified by Purchase Agreement or Contract.
4. This specification
5. Other applicable documents

Referenced documents:

ASTM B265 - Material Specification (Ti2Al2.5V; Ti b21S)  
AMS 5599 - Material Specification (Inconel 625)  
AMS 5596 - Material Specification (Inconel 718)  
AMS 5513 - Material Specification (Stainless Steel Gr. 304)  
AMS 5524 - Material Specification (Stainless Steel Gr. 316)  
AMS 5507 - Material Specification (Stainless Steel Gr. 316L)  
ASTM C271 – Test Methods Specification

## 3. GENERAL DEFINITIONS

Core – Welded assembly of ribbons forming cellular structure

Core length (L) – Measurement in direction of the ribbon

Core width (W) – Measurement perpendicular to the direction of the ribbon

Core thickness (T) – Perpendicular distance between faces of the core

Cell – enclosed area formed by attached ribbons

Cell size – Perpendicular distance between opposite and parallel cell walls

Foil – Sheet or strip of metal as received from mill

Node – Conjoined (welded) area of two ribbons

Ribbon – formed (corrugated) foil

Perforated Core – Core fabricated with one or more perforations per cell wall

## 4. HONEYCOMB CORE CODES

The purpose of the core code is to define core configuration. Core code shall contain 7 or 8 numbers and letters as following:

XX-X-XX-XX

				L Core finish (F – finished both surfaces, R – rough, F/R – finished one side)
				L cell modification (N – non-perforated, P – perforated)
				L material thickness in tens of thousands of an inch
				L cell size in sixteenths of an inch
				L cell configuration (S – smooth, C – corrugated, D – deep corrugated)
				L cell type (H – hexagonal, S – square)

Example:

SD-6-35-NF

				L Finished core
				L cell modification: N– non-perforated,
				L material thickness: .0035"
				L cell size: 6/16" (.375")
				L cell configuration: D – deep corrugated
				L cell type: S – square

## 5. RAW MATERIAL REQUIREMENTS

Following materials to be used to manufacture honeycomb core covered by this specification:

Ti-3Al-2.5V (per ASTM B265)

Ti Beta21-S (per ASTM B265)

Inconel 625 (per AMS 5599)

Inconel 718 (per AMS 5596)

Stainless Steel (Grades 304, 316, 316L per applicable AMS specification)

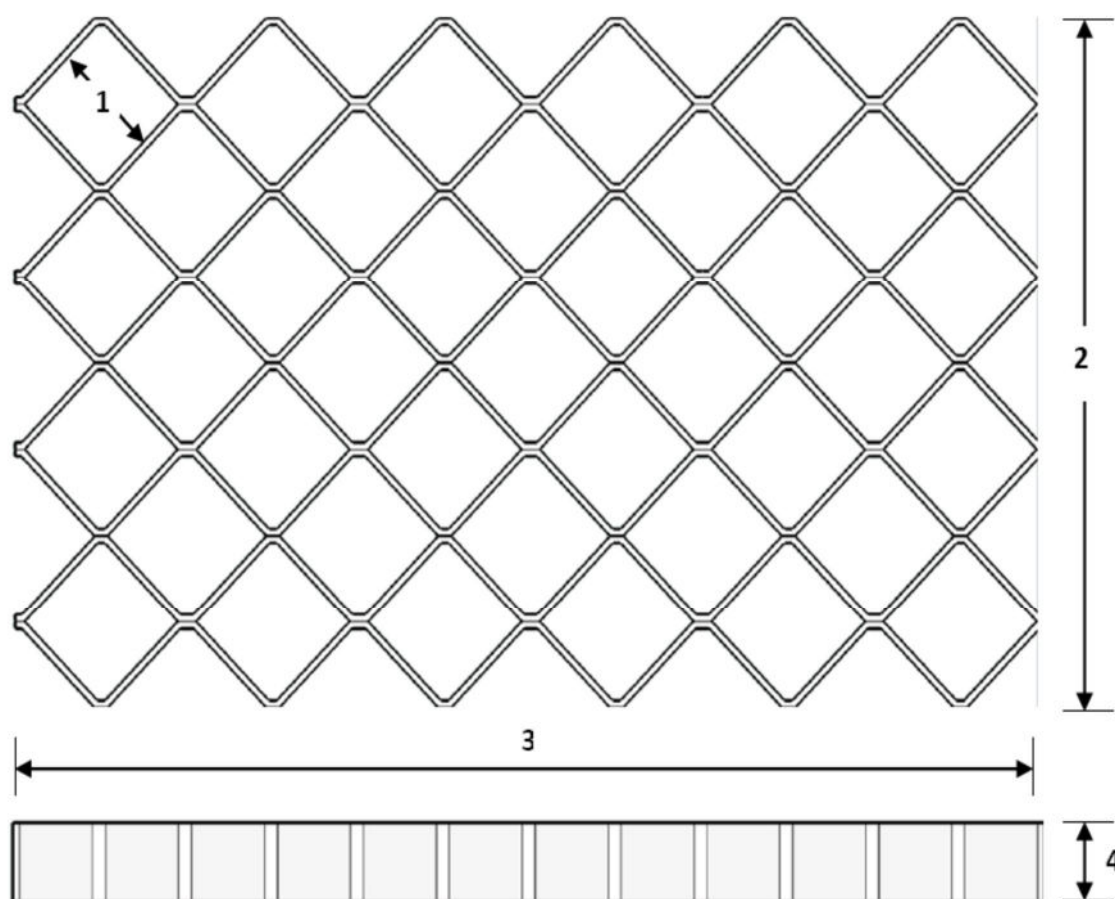
The type of material defines the requirements to mechanical properties of honeycomb core as described in paragraphs 6.3, 6.4 and 6.5.

Material must conform to the applicable specification unless approved by Indy Honeycomb and Purchaser.

## 6. HONEYCOMB CORE REQUIREMENTS

Refer to **FIGURE 1** for dimensional interpretation of honeycomb core.

**FIGURE 1.**



1. Cell size.
2. Width.
3. Length (Ribbon direction)
4. Core Thickness.

## 6.1. Dimensions and Tolerances

If tolerances on dimensions are not specified on the purchase agreement, the following tolerances on dimensions of the core blanket shall apply:

Length (L) – 0/+1.00”.

Width (W) – 0/+1.00”.

Thickness (T) – Finished +/- .003”; – Rough +/- .030”.

Flatness - finished core shall conform to a flat surface within .010” under hold-down pressure of not more than 7 pounds per square inch for finished core.

Localized surface steps (vertical mismatch) exceeding .003” are not permitted on finished core.

Core Angles - The angle between the core node axis and the core faces shall be  $90 \pm 3$  degrees.

Perforations - one or more perforations per cell wall, .010” -.035” laser drilled or mechanically punched holes.

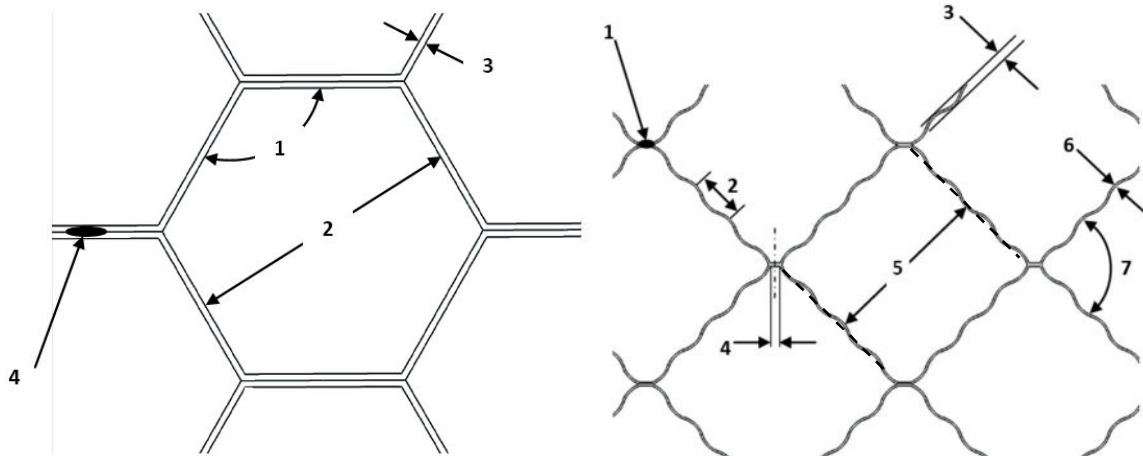
## 6.2. Cell configuration and Corrugation types

The size of any cell shall not be different from nominal size on more than 8%.

Refer to **FIGURE 2** for cell configuration.

Dimensional requirements for square cell identified in **TABLE 1**.

**FIGURE 2.**



- 1. 120° (reference)
- 2. Nominal Cell Size
- 3. Ribbon Thickness
- 4. Node Spot Weld

- 1. Node Spot Weld
- 2. Wave Length
- 3. Wave Height
- 4. Node Width
- 5. Nominal Cell Size
- 6. Ribbon Thickness
- 7. 90° (reference)

**TABLE 1 - Cell Corrugation (Square Cell)**

Cell size, in	Corrugation type	Node width, in	Wave length, in	Wave height, in	
				foil thk, in .002 -.003	foil thk, in over .003
<3/8"	Square, non-corrugated	.035 - .080	N/A	N/A	N/A
	Square, corrugated	.035 - .080	.050-.070	.007 - .024	.003 - .020
	Square, deep corrugated	.035 - .080	.090-.110	.012 - .035	.013 - .033
≥ 3/8"	Square, non-corrugated	.035 - .080	N/ A	N/A	N/A
	Square, corrugated	.035 - .080	.070-.090	.012 - .031	.012 - .031
	Square, deep corrugated	.035 - .080	.120-.140	.019 - .044	.021 - .038

### 6.3. Welding

To assure weld quality weld schedule (router) for all material types and thicknesses shall be established and followed.

Weld quality shall conform to the following:

- Burn through holes - maximum of 8 (eight) holes per inch of core thickness per square foot. No hole shall exceed half of the node width or .030" whichever is less.
- Edge burnout - maximum of five .030" depth edge burnouts per square foot per side allowed
- Side expulsion - side expulsion shall not occur on more than two percent of the total nodes or more than four adjacent nodes in any direction
- Node mismatch - shall not exceed 1/3 of the width of node
- Welds shall be uniformly spaced along the node length (core thickness)
- Node shear tests shall be performed every 6 hours of production, after changing of welding parameters or electrode(s) replacing. Minimum 9 (nine) adjacent nodes shall be tested. Node weld strength shall meet requirements defined in **TABLE 2**
- Number of welds per node shall be in accordance with **TABLE 3**

**TABLE 2. Node shear strength per inch of depth**

Foil thickness	Ti-3Al-2.5V	Ti Beta21-S	Inconel 625/718	Stainless Steel 304/316/316L
.0020	80	N/A	90	90
.0025	100	N/A	115	100
.0030	115	N/A	135	110
.0035	140	N/A	150	110
.0040	145	N/A	150	110
.0045	165	N/A	150	110
.0050	175	190	150	110
.0060 and over	200	N/A	150	110



**TABLE 3. Number of welds**

Core thickness, in	Min. number of welds
Up to .250	2 per node
.251 - .500	3 per node
.501 - 1.000	4 per node
more than 1.000	5 per inch

#### 6.4. Density

Densities of core defined in TABLE 4. Actual density of core shall be within +/- 8% of shown values.

**TABLE 4. Core density (lb. per cubic ft.)**

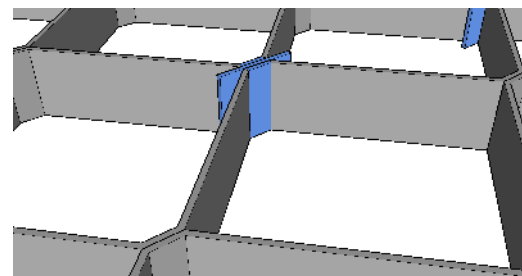
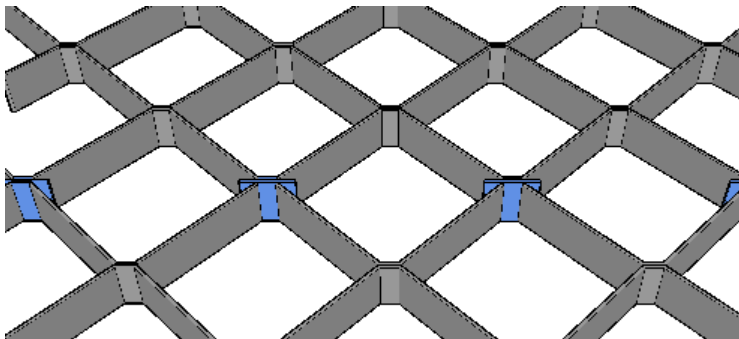
Core code	Ti-3Al-2.5V	Ti Beta21-S	Inconel 625/718	Stainless Steel 304/316/316L
<b>SC-4-25</b>	TBD	TBD	TBD	<b>7.3</b>
<b>SC-6-20</b>	<b>3.3</b>	TBD	<b>6.2</b>	TBD
<b>SC-6-25</b>	TBD	TBD	<b>7.6</b>	TBD
<b>SC-6-30</b>	TBD	TBD	<b>9.2</b>	TBD
<b>SC-6-35</b>	TBD	TBD	<b>10.8</b>	TBD
<b>SC-6-40</b>	TBD	TBD	<b>12.3</b>	TBD
<b>SC-6-45</b>	TBD	TBD	<b>13.9</b>	TBD
<b>SC-6-50</b>	<b>8.5</b>	TBD	<b>15.2</b>	TBD
<b>SD-6-20</b>	<b>3.3</b>	TBD	<b>6.2</b>	TBD
<b>SC-6-25</b>	TBD	TBD	<b>7.6</b>	TBD
<b>SD-6-30</b>	<b>5.4</b>	TBD	<b>9.2</b>	TBD
<b>SD-6-35</b>	TBD	TBD	<b>10.8</b>	TBD
<b>SD-6-40</b>	TBD	TBD	<b>12.3</b>	TBD
<b>SD-6-45</b>	<b>7.2</b>	TBD	<b>13.9</b>	TBD
<b>SD-6-50</b>	<b>8.7</b>	<b>8.7</b>	<b>15.2</b>	TBD

#### 6.5. Splicing and Rework

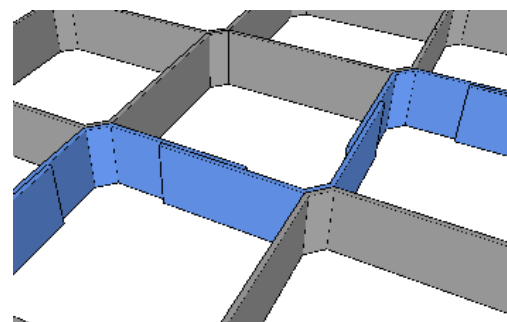
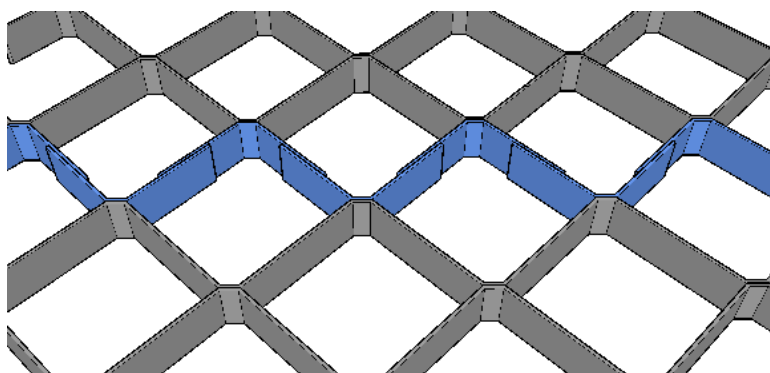
Refer to **FIGURE 3** and **FIGURE 4** for requirements of core splicing and rework methods. Splices shall be made by resistance spot welding at nodes and/or at cell walls. The weld joint shall be made the full thickness of the core with the number of welds per node as specified in **TABLE 3**. Splice welds shall meet shear strength requirements specified in **TABLE 2**.

**FIGURE 3.****A. Three-layer splice.**

1. Trim away cell walls.
2. Max flag .030".

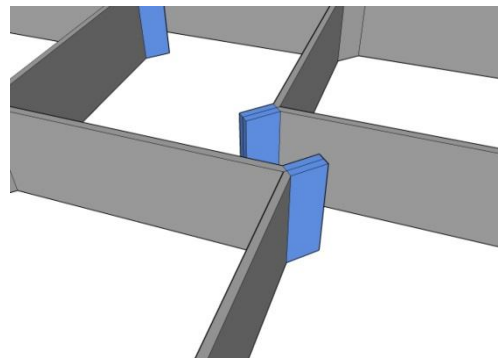
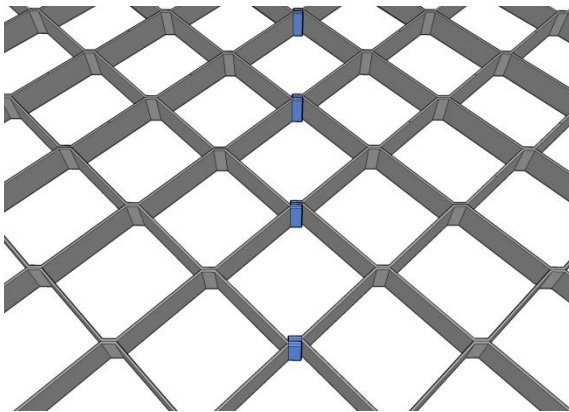
**B. Cell wall overlap.**

1. Max. overlap –  $\frac{3}{4}$  wall width.
2. Max cell reduction 50%.
3. Max cell increase 25%.
4. One direction single cell only

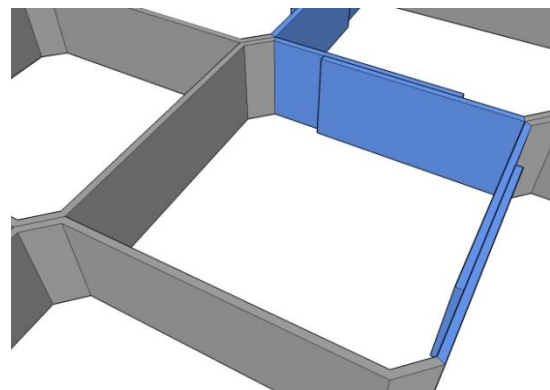
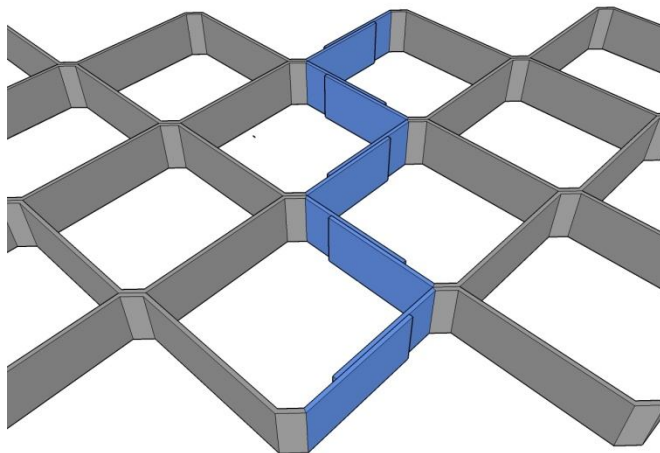


**FIGURE 3. (continued)****C. Transverse node overlap.**

1. Min. overlap – full node width.
2. Max. overlap node width plus .030" flag
3. Max cell reduction 50%.
4. Max cell increase 25%.

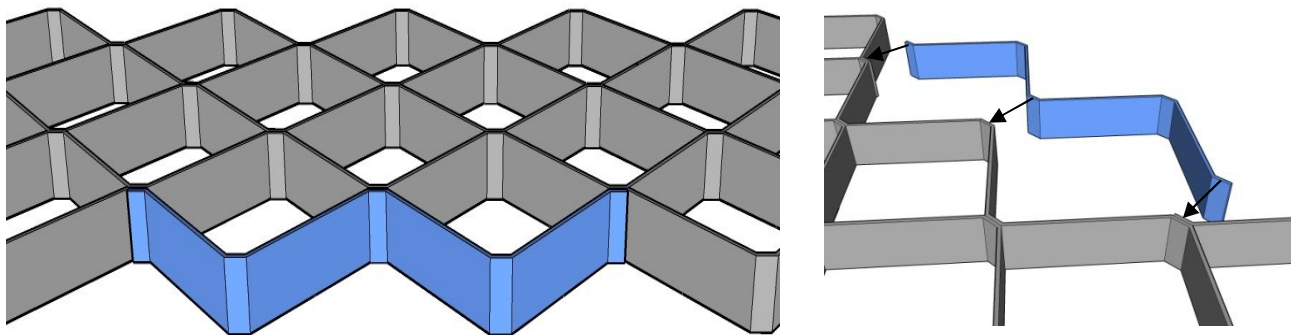
**D. Transverse cell wall overlap.**

1. Max. overlap –  $\frac{3}{4}$  wall width.
2. Max cell reduction 50%.
3. Max cell increase 25%.

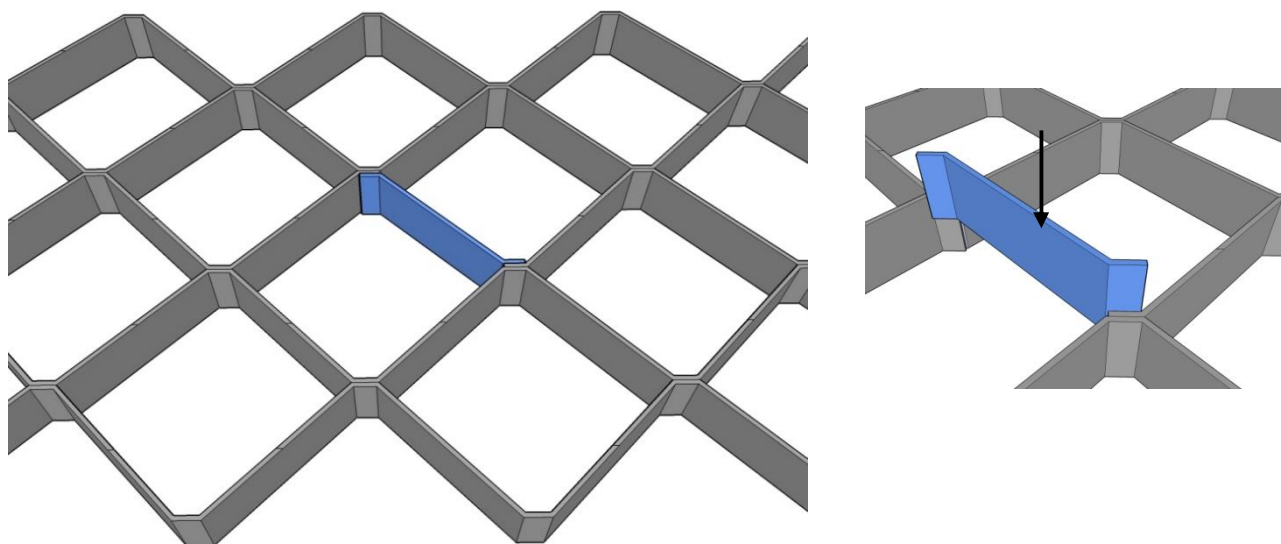


**FIGURE 4.****A. Partial ribbon insert.**

1. Cut away defective cell walls
2. Insert full depth ribbon
3. Min. overlap – full node width.
4. Max. overlap node width plus .030" flag

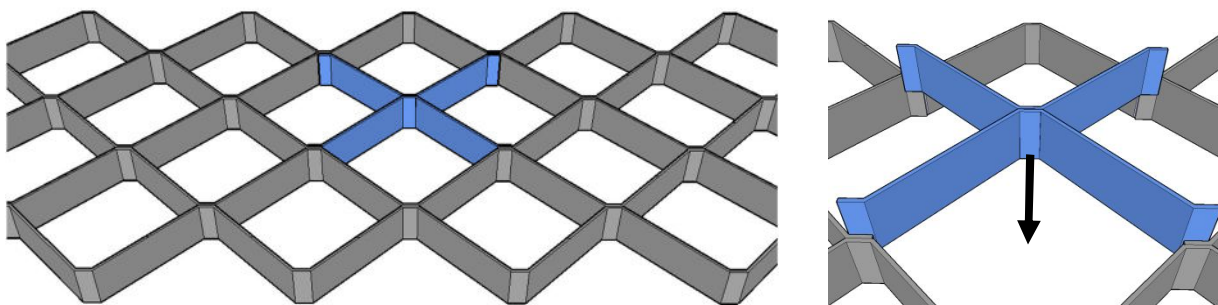
**B. Cell wall replacement.**

1. Cut away damaged cell wall.
2. Insert full depth replacement cell wall.
3. Min. overlap – full node width.
4. Max. overlap node width plus .030" flag.

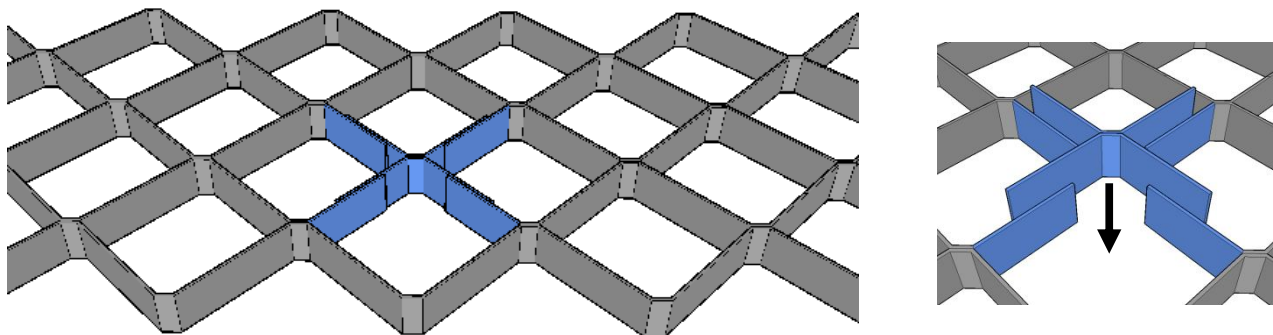


**FIGURE 4. (continued)****C. Node replacement inset, overlapped nodes.**

1. Cut away damaged node.
2. Insert full depth replacement node.
3. Min. overlap – full node width.
4. Max. overlap node width plus .030" flag.

**B. Transverse cell wall overlap.**

1. Max. overlap –  $\frac{3}{4}$  wall width.
2. Max cell reduction 50%.
3. Max cell increase 25%.



## 7. QUALITY ASSURANCE

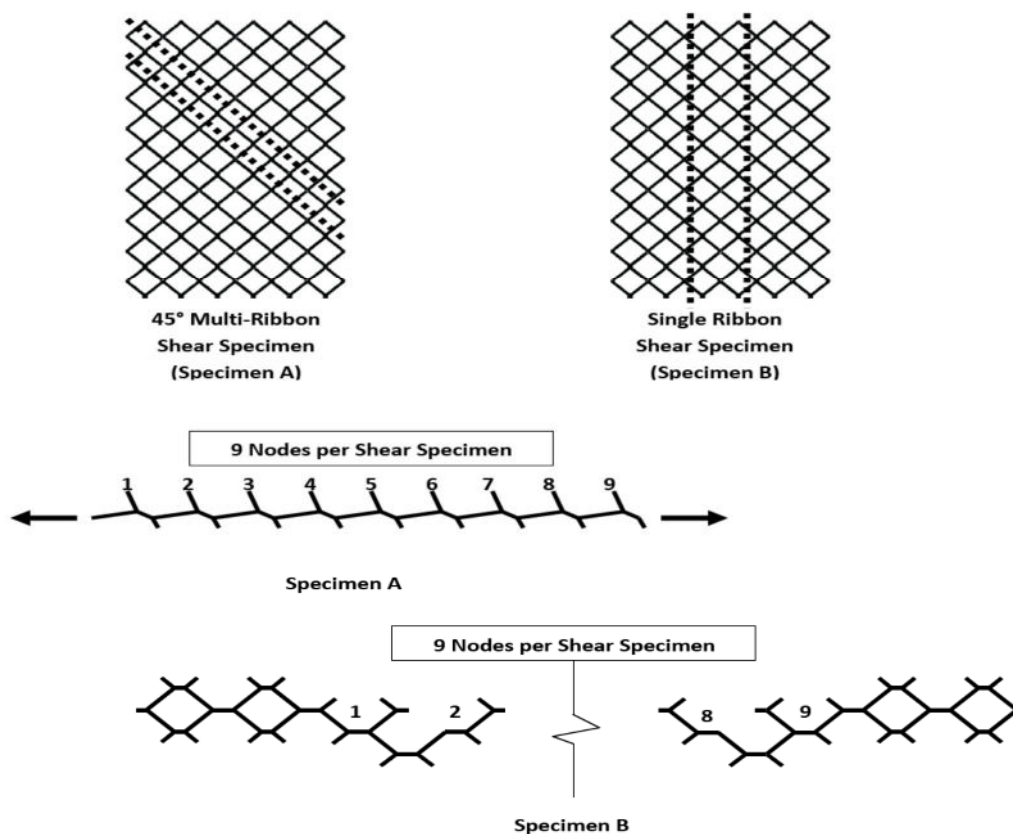
Core procured to this specification shall be subject to both Indy Honeycomb and purchaser inspection by authorized inspectors to determine compliance with requirements of this specification. All tests shall be made in accordance with this specification and values for the core compression, density and node shear shall be met.

Node shear shall be recorded and kept on file. Complete records of all applicable tests and certifications required by this specification shall be maintained. Records shall be made available to authorized representatives of purchaser and/or Indy Honeycomb upon request. Shipments of material from the Indy Honeycomb shall be accompanied by a statement that material meets the requirements of this and any other applicable documents.

### 7.1 Node shear strength

Node tensile shear specimens shall be cut in accordance with **FIGURE 5** and pulled in tension at a rate to produce failure within 1 to 3 minutes.

**FIGURE 5**



## 7.2. Core Density

The core density shall be determined on blankets by dividing the weight in pounds by the volume in cubic feet. Measurement to be performed per **ASTM C271**. Density shall meet the requirements of Paragraph 6.4.

## 7.3. Core condition

Honeycomb core shall be uniform in quality, clean, free from foreign materials and show no evidence of node separations, bent over cells, broken ribbons or other defects. Core shall not be in contact with lead or mercury. Use of lead-based alloy tools or zinc, tin or cadmium-plated tools or fixtures is prohibited. Acceptable defect limits are listed in **TABLE 6**

**TABLE 6. Maximum number of core defects per square foot**

Type of defects	Cell size, in				
	1/8	3/16	1/4	3/8	1/2
<b>Node separation</b>	<b>40</b>	<b>30</b>	<b>25</b>	<b>20</b>	<b>15</b>
<b>Splits or tears</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>
<b>Buckling of nodes*</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Splits or tears**</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

Cell with separated node shall have at least three acceptable adjacent nodes on each side when located on the same ribbon. A node shall be considered separate if a 0.005" shim can be inserted to a depth 1/2 the core thickness.

\*Buckling of nodes is not acceptable as determined visually. Buckling of the cell walls shall not be cause for rejection.

\*\*Splits or tears starting at the ribbon edge and extending 0.030" or less are acceptable. All other tear defects in the cell wall are not acceptable.

## 8. Packaging and Marking

### 8.1. Packaging

Packaging shall be accomplished in such a manner as to assure prompt delivery with the core materials retaining the properties required in this specification. Individual core block and blanket shall be packaged to allow removal from the packages without damage to the core materials.

All core material shall be protected from contamination substances such as moisture, dirt, dust, oil, grease, paint, etc.

Shipping containers shall be sufficiently strong to prevent core damage during shipment.



## 8.2. Marking

Interior packages and exterior shipping containers shall be durable and legibly marked. The following information shall be placed on each interior package so that the markings will not be damaged when the packages are opened:

- Purchase Order Number
- Date of Shipment
- Alloy
- Core Code
- Core Material Identification
  - Core Cell Size
  - Core Foil Thickness
  - Core Density (optional)
  - Core Thickness
  - Core Length (actual)
  - Core Width (actual)
- Date of Manufacturing

Container shall be labeled as follows:

THIS SIDE UP, FRAGILE – HANDLE WITH CARE